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The Modification of Rigidity in Geriatric Patients Through Operant Conditioning.

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THE MODIFICATION OF RIGIDITY IN GERIATRIC
PATIENTS THROUGH OPERANT CONDITIONING.

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THE MODIFICATION OF RIGIDITY IN GERIATRIC PATIENTS
THROUGH OPERANT CONDITIONING

A Dissertation

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in

The Department of Psychology

by

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ABSTRACT

The possibility of overcoming rigid behavior is an important question in regard to the efficacy and efficiency of rehabilitative efforts with aged individuals. The purpose of this study was to demonstrate that rigidity in aged subjects could be modified (reduced) through training by operant conditioning. Though this study was not a test of any particular theory of rigidity, the Goldstein formulation was utilized as a basis for defining rigidity and providing a model for developing appropriate tests. Rigidity was defined operationally as the inability of subjects to shift their attention among randomly presented concepts in a problem solving task. Two simple concept formation tests were devised, one of which provided an initial measure of rigidity and served also as the training task (the Figure Test). The second test (the Card Test) served as a measure for generalization of training. The measure of rigidity was defined by the error scores achieved on the tests. The subjects were assigned to one of three levels of rigidity according to their scores in the pretraining phase of the Figure Test.

One of three types of rewards was utilized to condition the subjects' ability to shift among concepts. The rewards were a positive verbal statement, a penny, and the sound of

a tap bell; and these were given for every correct response during retest on the Figure Test. A control group received no reward during retesting. The subject sample consisted of 72 geriatric-psychiatric patients in a V.A. psychiatric hospital. They ranged in age from 65 to 81 years (mean age 69.6 years) and were grossly diagnosed either chronic brain syndrome or psychosis.

Three specific hypotheses were tested: (a) rigidity can be modified through training by the application of positive reinforcements, (b) verbal and nonverbal reinforcers will differ in their efficiency in modifying rigidity, and (c) the modification of rigidity in one behavioral area will generalize to modify rigidity in a related behavioral area.

Analyses of variance based on error scores of the two concept formation tests produced the following results. A significant training effect ($p < .05$) was demonstrated between the pretraining and training scores of the Figure Test; this data supports the first hypothesis. No significant differential reward effect occurred, negating the second hypothesis. The latter finding in conjunction with the significant training effect indicates that some other variable was effecting a change during training, probably social facilitation. No generalization effect was elicited on the Card Test, negating the third hypothesis. This finding indicates how situation-bound the training might be.

Diagnosis was not a significant variable. There were significant differences among the levels of rigidity ($p < .01$).

The variables of age and IQ (WAIS vocabulary subtest) were correlated with the test scores. Age was found to be inversely related to the error scores of both tests, suggesting that rigidity does increase with age. IQ was directly related to the error scores, suggesting that with increased rigidity intellectual efficiency decreases. The overall conclusions from the data were that rigidity is not an irreversible phenomenon, that it can be modified through conditioning. Rigidity, then, is not an insurmountable obstacle to rehabilitative programs applied to aged individuals.

INTRODUCTION

Rehabilitation in Geriatrics

Due to vast improvements in medicine, working conditions, social security, etc., the average life span of individuals in this country has been considerably extended beyond that found 30 years ago. Concurrent with this trend are increases in the demand for services to this older portion of the population--services stemming from public health and welfare, social security, and rehabilitation. A need for research both in the aging process, per se, and in rehabilitation of the aged individual has also been widely acclaimed (Birren, 1960, p. 161).

The medical field of geriatrics, in particular, reflects the upward trend in aging both in the increase of medical problems associated with senility and in the allocation of hospital space to treat these problems. Geriatric units in a psychiatric setting must be concerned not only with the treatment of physical disorders but the complicating effects of mental disturbance. For such patients the physical and mental conditions are most often interrelated, e.g., impaired mental functioning stemming from cerebral arteriosclerosis. Rehabilitative efforts directed toward geriatric patients must take into account the amount of permanent physical and mental disability as well

as the potential for changes toward adjustive behavior.

Until recent years, the treatment of geriatric cases was principally physical and custodial in nature. The modern trend is toward remotivation and resocialization. These latter two procedures constitute the primary goals of rehabilitation for the geriatric-psychiatric patient. For younger people rehabilitation usually includes vocational training and job placement, but such an aim is not nearly so important with aged individuals. The goals of rehabilitative efforts applied on a geriatric-psychiatric ward may be as simple as training the patient to care for his own immediate needs such as personal hygiene or self feeding and improved eating habits. Hopefully, the ultimate goal is to prepare the patient for placement outside the hospital where responsibility for meeting ones own needs is required. The term rehabilitation, as applied to these patients, obviously is much more restricted in meaning than when used with younger people.

Important Variables in Rehabilitation

The effectiveness of rehabilitative efforts directed toward the geriatric-psychiatric patient is influenced by a multitude of variables. One set of these variables constitutes the dimensions of personality including self concept, intelligence, expectancies, emotions, and rigidity (Botwinick, 1959; Kahlen, 1959; Riegel, 1959). Another set of variables,

and one of primary importance to rehabilitation, are those related to learning ability (Kay, 1959; Jerome, 1959).

These learning variables include, among others, reinforcement, motivation, generalization of training, and memory. A third set of variables constitutes physiological attributes of individuals, e.g., age, central nervous system activity, sensory acuity, or disease.

Among the three sets of variables listed above, there is much overlap and interdependence. The current study was designed to investigate the interrelationships between several of these variables in the context of training and rehabilitation. More specifically, the concern was with the influence of these variables upon the modification of behavior in geriatric patients, behavior that is important to adequate adjustment in the late years of life. With regard to the importance of learning variables, for example, Anderson, Bryant, and Gilbreth (1961) point out that "many of our action programs for older people depend directly upon their capacity to acquire new skills or to modify old ones." The particular variables chosen for investigation in the present study were the personality dimensions of age and rigidity, the learning variables of reinforcement and generalization of training, and the physiological variables of age and brain damage.

Rigidity

Definition. There are a number of theoretical formulations to account for the nature and origin of this phenomenon. These positions have been questioned and criticized. Chown (1959) and Werner (1946) have reviewed the concept of rigidity and concluded it was ambiguous and difficult to define. Cattell and Tiner (1949) stated that for some 30 years rigidity was studied under the rubric of perseveration without any confusion or major disagreements. In recent years, however, "newcomers" lent confusion to the area by failing to consider and integrate the previous work on perseveration. Out of this, then, has arisen the diversified theoretical approaches to the concept of rigidity.

Chown (1959) has reviewed several measures of rigidity. These include the einstellung tests such as the Luchin's Water Jar Test, concept formation tests such as the Weigl Card Sorting Test, personality inventories, and the Rorschach. Because of the varied theories and measures, the question is often asked, Is rigidity a generalized personality trait or is it phenomenally related to the specific experimental conditions under which it is generated and measured? Schaie (1955) in an attempt to answer this question formed a test battery from six "tests of high reliability and validity based on independent criteria of behavioral rigidity . . ." Two tests were related to functional theory, two to structural theory, and two were

rigidity scales, one of which was devised by Schaie. Test scores were obtained on all measures from 216 subjects ranging in age from 17 to 79 years, with a mean age of 38 years. Factor analysis of these results showed no general factor of rigidity. Chown (1961) factor analysed 18 tests of rigidity (not including the einstellung or concept formation tests) and found five factors of rigidity.

The existence of a unitary rigidity factor still remains a controversial issue; however, the trend is to consider rigidity a multiform concept. English and English (1958) give a generalized definition of psychological rigidity which reflects the multiform approach. Rigidity is defined as the "relative inability to change one's action or attitude when the objective conditions demand it; clinging to a no-longer-appropriate way of acting or feeling." They state further that it may be "cognitive," "perceptual," "affective," or "show itself in overt action."

Goldstein Theory. Of the many prevailing theories of rigidity the one formulated by Goldstein (1943) was chosen to provide a theoretical foundation for the present study. Though this study was not designed to test any particular theoretical position on rigidity, Goldstein's approach has practical value in the study of geriatric-psychiatric patients. It provides an operational definition of rigidity, and suggests a measure suitable in part to geriatric

patients. The applicability of the Goldstein theory to geriatric-psychiatric subjects in particular will be discussed later.

Rigidity is defined by Goldstein as an "adherence to a present performance in an inadequate way, i.e., not corresponding to the situation" (Goldstein, 1943). He considers rigidity to be of much importance even in normal behavior and thinks that it affects both physical and mental performance. It is especially pronounced in pathological states. When a part of the central nervous system becomes anatomically or functionally separated, rigidity results following stimulation of the isolated portion. Isolation of parts of the central nervous system occurs under two conditions. First, abnormally strong stimuli can lead to a functional isolation with subsequent inhibition of normal reactions. Goldstein cites afterimages as an example of this type of isolation. Such a condition results in primary rigidity and may involve subcortical structures. The second condition creating isolation of parts is found in cortical pathology. This induces a defect of higher mental processes and leads to secondary rigidity. Not all tasks are affected by secondary rigidity, rather, only those with which the organism cannot cope. Rigidity, then, represents an escape or avoidance of a "catastrophic situation." Primary rigidity is independent of cortical pathology and

basically is a lack of ability to change set. Secondary rigidity is essentially an impairment of "abstract thinking" and a resultant of cortical pathology.

Goldstein and Scheerer (1941) distinguish between two attitudes or levels of thought--abstract attitude and concrete attitude. The concrete attitude is free from conscious activity such as reasoning, awareness, or self-account. It is unreflective in character and "confined to immediate apprehension of the given thing or situation" The immediacy of this experience can acquire the characteristic of rigidity or "lack of shifting." An abstract attitude implies conscious activity such as reasoning and awareness. Goldstein and Scheerer list eight "conscious and volitional modes of abstract behavior." Examples of these are as follows:

1. To shift reflectively from one aspect of the situation to another.
2. To grasp the essential of a given whole; to break up a given whole into parts, to isolate and to synthesize them.
3. To abstract common properties reflectively; to form hierarchic concepts.

Normal people, according to Goldstein, utilize both abstract and concrete attitudes and are able to shift between them as demanded by the situation. In organic (cortical) pathology the disintegration of behavior stems from an

impairment in the capacity for abstract behavior; i.e., there is reduction to the concrete level in thinking and acting. Subsequently, the individual exhibits secondary rigidity and becomes more stimulus bound.

Measure of Rigidity. The special tests of Goldstein and Scheerer were devised to illustrate these attitudes and behaviors, and they provide measures suitable in part, at least, to a geriatric population. Because of the restricted psychological and behavioral makeup of this geriatric population, the choice of an experimental task becomes more difficult. These patients often have communication difficulties even though their thought processes remain intact. Additionally, they tend to tire easily with a subsequent decrease in attention span. For these reasons, measures of rigidity that rely heavily on verbal ability, that are even moderately complex, or that take a long while to administer are not suitable for this type of subject. Concept formation types of rigidity measures appear to avoid these difficulties. They can be simple in content and administration, need not emphasize verbal ability, and lend themselves to objective scoring. The series of special tests devised by Goldstein and Scheerer are of this type. These tests have been criticized on the basis that they are qualitative rather than quantitative measures, are poorly standardized, and are not supported by normative data (Buros, 1949).

One particular test of this series which seems suitable with respect to content is the Color-Form Sorting Test. Here the concepts of color and form are combined in plastic blocks. The measure of rigidity or, according to Goldstein, the extent of abstract attitude, is the ability to shift from one concept to the next--the more rigid person being unable to shift concepts in sorting the blocks. The Color-Form Sorting Test, however, does not provide enough opportunity to shift among concepts for a number of times. Therefore, it was not considered quite appropriate. Similar tests have been devised in which these concepts (color, form, number, etc.) are displayed on cards. Such an arrangement provides for a variety of combinations of concepts and a large number of possible shifts. Examples of this technique are the Wisconsin Card Sorting Test and the Weigl Card Sorting Test. The mode of presentation in these latter tests and the simple concepts of the Color-Form Sort Test provided the bases for devising a rigidity measure in the present study.

Age and Rigidity

What is the relationship between old age and the variable of rigidity? Answers to this question are not readily available in the literature. Extensive reviews of studies dealing with the aging process have been made by Birren (1959, 1960). His conclusions are that little is known or

has been studied systematically with respect to the aged person. Most studies investigating the aging process have used as subjects either children or young adults, even infrahuman subjects. Extensive research with aged individuals is definitely in order.

Riegel (1959) has reviewed the area of age and rigidity and found very few studies utilizing aged subjects. Heglin (1956) used the Luchin's Water Jar Test and an alphabet maze test, administering it to three groups of subjects with median ages of 16.06, 31.75, and 62.02 years, respectively. The inability to change set was the criterion measure of rigidity. The results showed that older subjects exhibited the highest degree of rigidity, younger subjects the least. Schaie (1958) tested 500 adults ranging in age from 20 to 70 years, divided into 5-year groups of equal size. His measures were the Thurstone SRA Primary Mental Abilities Test and the Schaie Test of Behavioral Rigidity. The results indicated a significant decrease in all measures of mental abilities and a significant increase in all measures of behavioral rigidity with advancing age. Kuhlen (1959) reviewed a series of 19 studies on old age and the variables of conservatism, dogmatism, and rigidity. He summarized the findings by saying that with advancing age people generally become more conservative, dogmatic, and rigid in their behavior and attitudes. Bromely (1953) tested 35 subjects aged 40 to 80 years, using the Raven's Progressive Matrices

Test. His results indicated that the older subjects were less able to shift from one idea to another or to hold two or more aspects of the patterns simultaneously. It is interesting to note that these inabilities defined by Bromely are evidence of rigidity and concrete attitude described by Goldstein. The four studies just summarized appear to justify the consideration of rigidity as a characteristic of the aged individual.

Relevance of the Goldstein Position. Impaired brain function often is a concomitant of aging beyond 65 years. This is due directly to anatomical and physiological changes in the central nervous system itself or indirectly to changes in other systems, principally the cardiovascular network. Marks (1961) stated that the frequency of cerebral vascular changes increases rapidly with advancing ages; changes of a serious degree are common in older people. He also stated that as one major cause of death, cerebral vascular disease is most characteristically associated with advanced age. With respect to Goldstein's theory of rigidity, the empirical evidence upon which it is based derived from clinical observations of brain damaged subjects. Secondary rigidity, in particular, results from cortical pathology. It is highly conceivable, then, that the rigidity displayed by aged individuals is related in some degree to organic involvement. Since many geriatric-psychiatric

patients are diagnosed as having chronic brain syndromes, the Goldstein position is considered by this writer to be quite appropriate for explaining rigidity in this group of subjects. It is probably as appropriate for aged subjects in general.

Intelligence and Rigidity

It is reasonable to hypothesize that there is a significant and positive relationship between the variables of intelligence and rigidity. This will probably vary, however, with the type of rigidity measure. Most intelligence tests employ some type of concept formation task, hence a rigidity measure based on such a task might well correlate highly with an intelligence measure. Chown (1961) investigated this relationship using rigidity measures other than the concept formation type. She factor analyzed test scores from 18 different rigidity tests taken by 200 subjects ranging in age from 20 to 82 years. In her results she found that the age and intelligence components could not be separated, but these two components together accounted for 30 per cent of the total test variance.

A more specific indication of the relationship between intelligence and rigidity in aged subjects is found in the following study. Esbenshade (1960) used two groups of subjects 16 to 24 years of age and 64 to 82 years. The hypotheses tested were: (a) with intelligence held constant

there would be no group differences in rigidity, and (b) with age held constant the dull subjects will be more rigid than a brighter group. The measure of intelligence was obtained from the Raven's Progressive Matrices Test. Rigidity was measured by the Luchin's Water Jar Test, a level-of-aspiration test, and the University of Wisconsin Card Sorting Test. The results indicated that dull subjects were more rigid than bright ones, and that rigidity bears no significant relationship to age, per se. The latter result is in contradiction to the general findings and conclusions described in the section on age and rigidity.

Rigidity and Learning

As mentioned earlier, learning is one of the primary processes in rehabilitation; therefore, the influences of rigidity upon learning should be considered. Kay (1959) states that "often learning involves unlearning, and this inability to modify responses, classed as rigidity and resulting in continuous error repetition, is a hallmark of slow learners." This last statement points up the issue of whether rigidity in behavior is a reversible or a permanent condition, yet none of the theoretical positions on rigidity indicate the relative permanence of such a characteristic. Certainly, this is an important question to consider while attempting to rehabilitate aged individuals. To clarify this issue, then, the modifiability of rigidity should be

demonstrated experimentally.

This writer has not found a single study which attempts to manipulate rigidity in aged subjects and only two that relate to this question. Buss (1952), using college students as subjects, studied the effect of continuous, partial, and differential reinforcement on the shifting of discriminations. The subjects were trained on a discrimination problem using the Vigotsky Test, then were required to shift or reverse discriminations. The ease of reversal was the measure of rigidity. The results showed that subjects trained under partial and differential reinforcement were able to reverse discriminations whereas those trained under continuous reinforcement could not do this. This study is not a manipulation of existent rigidity, but, rather, is a study in the development of rigidity.

In the other study Grant and Berg (1948) utilized the University of Wisconsin Card Sorting Test and college students as subjects to study the influence of degrees of reinforcement on the ease of shifting concepts. The reinforcer was a verbal "right" or "wrong," and it was varied in frequency. The results showed that with increasing amounts of reinforcement of the "original mode of response," the amount of perseveration decreased; i.e., a facilitation of new responses or solutions was demonstrated. The authors stated that "abstract attitude is either fostered or made

more effective by added reinforcement of the single correct response"; "greater flexibility results from the confirming function of reinforcement; i.e., reduces the ambiguity of the situation." This study is a good example of the type needed to show that rigidity is a reversible condition.

Operant Conditioning

The preceding studies by Buss, and by Grant and Berg suggest two methodological procedures that are suitable to a geriatric-psychiatric population for the modification of rigidity. The first is a concept-formation type of rigidity measure. Such a measure is completely compatible with the Goldstein-Scheerer theoretical framework and has already been discussed. The second procedure is the use of operant conditioning to modify existent rigidity. This technique has received much attention recently as a fruitful means of changing behavior in organisms both human and infrahuman. Bandura (1961) has reviewed the studies in which learning theory was applied as methods in psychotherapy. However, none of the studies was concerned specifically with the age variable. Krasner (1958), Salzinger (1959), and Greenspoon (1962) have reviewed the studies utilizing operant conditioning to modify verbal behavior. Age here, too, was not treated systematically.

Rewards. The reviews just mentioned discuss the types of rewards used by the various investigators. Krasner lists

three general types of reinforcers applied in verbal conditioning. These include verbal cues ("mmm-hmm," "good," "right," etc.), gestural cues (nodding of head, smiling), and mechanical cues (light flash, buzzer, and bell tone). Bandura (1961) and Ayllon and Haughton (1962) include food as a reinforcer. From among these various types of rewards, verbal cues and a bell tone were selected for use in the present study.

Money was thought by the present writer to be a good choice as a reinforcer for geriatric-psychiatric subjects. Money has been used as incentives in many psychological experiments and as a reinforcer in at least one recent experiment (Noblin, 1962). As part of the hospital routine for the subject population in the present study, the patients' funds were closely supervised and controlled. Such a procedure appeared to increase the importance of money to the patient, and may even have become a symbol of independence. Some of the patients were indigent, hence money for these subjects was supposedly of more basic importance. For these reasons, then, money was chosen as a reinforcer in the present study.

Generalization. Bandura (1961, p. 150) states that, "So far the study of generalization and permanence of behavior changes brought about through operant conditioning methods has received relatively little attention, and the scanty data available are equivocal." This reviewer listed

only three conditioning studies in which generalization to "extra experimental situations" occurred.

Generalization in a concept formation task was investigated by Buss (1950). Using 100 college students as subjects and a set of tall, medium, and short blocks similar to the Vigotsky Test, he rewarded the concept tall by the verbal reinforcers of "right" or "wrong." The subjects indicated their response to the stimulus by means of a reaction key. Response latency was the dependent variable. The results showed some generalization of the response tendency to the medium and short blocks. The generalization was least for the short blocks. From this study, then, one could expect generalization of training on one concept formation task to occur on another similar task.

Mednick (1955) investigated the differences in generalization between diagnostic groups. The subjects consisted of 60 schizophrenics, 60 cortical brain damaged individuals, and 60 controls who were medical cases without psychiatric involvement. The mean ages for each group were 43.4 years, 55.3 years, and 48.2 years, respectively. The subjects were to release a reaction key each time the middle light in a series of 11 lights was activated. Some generalization of this response was expected to spread in decreasing strength to activation of the lights further away from the center light. The results supported the hypotheses and showed that the brain damaged group generalized their response less than

the schizophrenics and controls. The schizophrenics, on the other hand, tended to overgeneralize as compared to the controls. The Mednick study is relevant to an investigation of the learning behavior of geriatric-psychiatric patients. A very large percentage of the patient population sampled in the current study were diagnosed either chronic brain syndrome, psychotic, or a combination of both.

Age and Generalization. The age variable has not been considered systematically in the above mentioned studies on generalization. Jerome (1959) acknowledged the importance of transfer of training in rehabilitating aged individuals and cited seven studies relevant to this area. In none of these studies was there conclusive evidence that age, per se, impaired an individual's ability to transfer training to related areas or to generalize in learning situations. The relationship between age and generalization of training is open for further research.

Old Age and Operant Conditioning. Only one study has been found by this writer in which operant conditioning was applied exclusively to a group of geriatric subjects. Dignam (1960) investigated the relative effectiveness of three types of reinforcement on modifying verbal behavior in geriatric subjects 60 to 78 years of age. The reinforcers were a verbal "umm-hmm" and a nonverbal smile or nod

of the head. The results were positive in that verbal behavior was conditioned successfully. Also, the three classes of reinforcers differed in their efficiency when applied individually or in combination. This study as well as the Bandura and Krasner reviews discussed earlier lend support to the use of operant conditioning as a behavioral modifier, even with geriatric subjects.

Summary of the Problem and Hypotheses

The present study was designed as an attempt to demonstrate experimentally the reversibility of behavioral rigidity in geriatric-psychiatric patients. The operant conditioning technique was utilized to manipulate this variable wherein rigidity would decrease through the application of positive reinforcement in a learning type experimental situation. A test of the generalization of this training was also made; and the relationship between age, intelligence, diagnosis, and rigidity was analyzed. Three specific hypotheses were tested:

1. Rigidity can be modified through training by the application of positive reinforcement.
2. Verbal and non-verbal reinforcers will differ in their efficiency in modifying rigidity.
3. The modification of rigidity in one behavioral area will generalize to modify rigidity in a related behavioral area.

METHOD

Subjects

The patient population from which the subject sample was drawn consisted of those patients 65-years of age or older in a 1000-bed V.A. psychiatric hospital. This population totaled approximately 175 male patients or about 20 per cent of the average daily patient load. They were distributed throughout five different psychiatric wards including the chronic infirmary or geriatric unit. Only two restrictions were placed upon the selection of subjects for this study. First, the individual had to be able and willing to cooperate with the experimental procedures. Second, the person could not be suffering from a serious debilitating physical illness like blindness or rare brain syndromes such as Huntington's Chorea or Alzheimer's disease.

To facilitate the selection of subjects, a list of eligible patients was compiled and presented to one or two nursing assistants who were very familiar with those patients in his unit. The nursing assistant in turn indicated which patients he felt were uncooperative, questionable, or cooperative. Though no statistics were compiled for these ratings, it was found that the raters were quite accurate in their appraisal of the patients' cooperativeness.

Attempts were made to test several of the questionable and uncooperative cases to no avail.

Concept Formation Tests

Two simple concept formation tests were developed for this study. One served as a measure of rigidity and as the learning task; the other served as a measure of generalization. One test was constructed in the following manner. On a set of 18 five-by-eight inch, plain, white cards were mounted cutout figures of various shapes in three sizes and four colors--blue, green, red, and black. Each individual card contained only three geometric figures (see Appendix A). The 18 cards were paired, making two sets of nine cards; the first was designated as the constant series. The figures used on these cards were squares, circles, or triangles and were red, green, or blue in color (no black figures). One of the three concepts--size, shape, or color--was held constant on each of these nine cards (see Appendix B). For example, if the concept triangularity was to be represented the card would contain three triangles of different colors and sizes. If the concept were size there would be a circle, square, and triangle of different colors but all the same size. The second set of nine cards was designated the variable series, and all of the cards contained three figures on each. Six of the cards contained the figures of octagon, four-pointed star, and a cross and

varied in colors of red, blue, and green. The other three cards contained two different figures of either octagon, star, or cross, and a third figure of either a circle, square, or triangle. The figures on these latter three cards were black in color (see Appendix B). This test is referred to henceforth as the Figure Test.

The second test consisted of another set of 18 cards devised as a measure of generalization. This series was organized in the same manner as the Figure Test except that the stimulus materials were playing cards mounted three per five-by-eight card. The concepts on this test, the Card Test, were suits (clubs, diamonds, hearts, spades), numbers (threes, fives, sevens), and colors (red, black). The constant series in this test contained the numbered playing cards three, five, seven. In the variable series six of the cards contained the numbered playing cards two, four, six, or eight and one of the three, five, or seven variety. Appendix C contains a detailed description of the Card Test material. To cite an example from the constant series of this test, consider the concept of number. The card representing this concept would contain, say, three fives of different suits and either in two blacks and one red or two reds and one black. The card from the variable series which was paired with this constant card would contain, say, an eight, a six, and a five all of different suits and color (black and red).

Other common features between the two tests include the following. Each member in the constant series was paired with a member in the variable series, and the two were always displayed together. All of the individual figures (or playing cards) were placed randomly on any one five-by-eight card with respect to sequence (left to right orientation) or concept (size, shape, number, suit, etc.). This was done to prevent position learning. All of the paired cards were presented in random order thereby requiring the subjects to shift concepts constantly in order to make a correct response. The material for either test was presented such that the nine cards in both series were stacked side by side before the subject. The constant cards were in random order as described, but when exposed, they were always paired with their "mate" in the variable series. After the subject made his response to the two exposed cards on the top of the piles, these two cards were removed by the experimenter thus exposing the next two cards. The two piles of cards were always presented in the same sequence.

Testing Procedures

Two experimenters were used to collect the data, each of whom administered all the tests and rewards for a given subject. Each subject was tested individually in an office on the unit in which he was housed. Once the subject was seated, the set of Figure Test cards was introduced and the

task explained in the following words: "I have a set of cards I would like you to look at." The cards were then placed side by side before the subject with the constant series to his right, and the variable series to his left. The verbal directions continued with, "Now look at these figures here (the constant pile), then look at these over here (the variable pile). I want you to point out which one of these figures (on the variable card) goes with (matches or is the same as) all three of these over here (the constant card)." These directions were altered or elaborated as needed to convey to the subject the nature of the task and how he was to indicate his answer. If a subject appeared hurried or rushed in his responses, he was asked to take his time and study the material carefully. Once a subject indicated his choice for a pair of cards, the experimenter merely tabulated the position number of the figure pointed to on the variable card (position 1, 2, or 3, right to left). The two sets of nine cards were presented four times, making a total of 36 trials per session for a complete test.

During the first session the Card Test was also administered following the Figure Test. It was introduced by telling the subject, "I have another set of cards for you to look at. I would like you to do the same thing on these as you did on the last set." After the cards were displayed,

the same instructions for the Figure Test were given and the response scored as before. The Card Test consisted of 36 trials, and the responses for each test were scored later for the number of errors. These error scores constituted the pretraining scores for the Figure Test (F_1) and the Card Test (C_1). Each subject was administered the same tests again in two more sessions. The second session was held approximately seven days later, and only the Figure Test was administered. The third session was held approximately 24 hours after the second one, and only the Card Test was given followed immediately by the WAIS vocabulary subtest.

To make a correct response on each trial of either test, a subject had to shift his attention from one concept to another as they were presented to him in random order. Any tendency to perseverate a response pattern would, of course, increase the number of errors in a block of trials. Since perseveration was considered to be the main source of error variance, the error score obtained on 36 trials of the Figure Test was taken as the measure of rigidity for this study. Three levels of rigidity were designated in this study based on the pretraining error scores of the Figure Test (F_1). The least rigid group (L_1) was composed of subjects whose error scores ranged from 3 to 14; the scores of the most rigid group (L_3) ranged from 21 to 35, and the middle group (L_2) scored from 15 to 21. There was a slight

overlap in scores between the L_2 and L_3 groups. The nine subjects with a score of 21 were randomly assigned to one of these two levels--four to L_2 and five to L_3 . Each level had a total of 48 scores.

Reward Procedures

To show that rigid behavior could be modified, the subjects were trained with the expectation of improving their ability to shift readily among the concepts on the Figure Test. More accurate shifting among the concepts was expected to result in fewer errors, hence a reduced total error score would represent decreased rigidity. This training in shifting was attempted by administering one of three types of rewards to a subject for every correct response he made in 36 retest trials on the Figure Test. One of the rewards was a verbal type in the form of the positive statement "right," "good," "correct," or "fine." A non-verbal reward was administered in the form of one penny for every correct response. The third reward was the sound of a tap bell rang after every right response. All subjects receiving one of these rewards was told before testing began that he would be given one for each correct response. The subjects tested in the first session (pretraining) were divided into four equal groups and assigned at random to a reward group. The fourth reward group was, in fact, a control group who were retested without receiving any rewards. The reward groups were also

assigned in such a way as to have equal numbers of subjects from each of the three levels of rigidity.

The training by rewards on the Figure Test was conducted during the second testing session, and these error scores constituted the training scores of the Figure Test (F_2). Whether or not the training on shifting concepts would generalize to another task was expected to be reflected in the retest error scores of the Card Test. In the third session this test was administered exactly as it had been in the first test session. No rewards were given at any time for correct responses on this test. If generalization occurred, the error scores would decrease in value significantly. These error scores constituted the "training" scores on the Card Test (C_2).

Other Variables Included

Diagnosis was included as a variable in this study more as an afterthought than by predetermination. Fortunately, all the diagnoses carried by the subjects in this study could be placed in one of the two gross categories of chronic brain syndrome (CBS) or psychosis (Psych.). This variable was included in the analysis in hopes of showing a relationship between rigid behavior and brain damage. Such expectations follow from Goldstein's position discussed in the Introduction.

Two other variables included were age and IQ. The WAIS

vocabulary subtest, mentioned earlier, was chosen as a rough estimate of intelligence for three reasons: (a) it is well standardized, (b) there is some normative data on older subjects (Wechsler, 1955), and (c) it is considered to be one of the tests least susceptible to deterioration through aging (Wechsler, 1944). The raw scores from this test were used in the statistical analysis. The IQ variable was included to determine its relationship to performance on the concept formation tasks. Age was included as a variable for the same reason.

Summary of Experimental Procedures

The sequence and nature of the testing sessions can be summarized as follows:

1. First session

- a. Figure Test (pretraining scores, F_1)
- b. Card Test following the Figure Test (pretraining scores, C_1)
- c. Subjects were leveled for rigidity according to their Figure Test scores and were assigned to one of the four reward groups.

2. Second session, approximately seven days later

- a. Figure Test (training scores, F_2)
- b. Rewards were given for correct responses according to the predetermined grouping.

3. Third session, approximately 24 hours later

- a. Card Test, no rewards (training scores, C_2)
- b. WAIS vocabulary subtest following the Card Test.

Statistical Analysis

An analysis of variance was chosen as the basic statistical design for this study, and, in particular, the Type III design described by Lindquist (1953). The test data was subjected to two such analyses. One was based on difference scores for each test-- F_1 minus F_2 , and C_1 minus C_2 , respectively--and the other was based on the pretraining (F_1) and training (F_2) scores of the Figure Test. Intercorrelations, means, and standard deviations were computed for all the variables--test scores, age, and I.Q.

RESULTS

Subject Sample

Out of the total geriatric-psychiatric population, 80 subjects were successfully tested. In order to keep the statistical design balanced with equal Ns in three of the factors, eight of the subjects were dropped from the analysis of variance, making a total N of 72. This deletion was achieved by the use of a table of random numbers. Twelve of the 80 subjects either refused or were unable to complete the WAIS vocabulary test. The intercorrelations between this variable and the others was based on an N of 68; all other correlations were based on an N of 80. For most of the subjects each test session lasted between 15 to 30 minutes.

Analysis of Difference Scores

The analysis of variance based on difference scores of both the Figure and Card Tests appear in Table 1. A difference score for the Figure Test (D_F) was determined by subtracting the score achieved by a subject on the test before training (F_1) from the score he achieved during training on the same test (F_2). A difference score for the Card Test (D_C) was determined in the same manner, i.e., by subtracting the initial score (C_1) from the score obtained on second

TABLE 1

Analysis of Difference Scores From the Figure and Card Tests

Source	df	SS	MS	F
Between Subjects				
Rewards (R)	3	72.13	24.04	<1.00
Levels (L)	2	6.68	3.34	<1.00
R X L	6	114.76	19.13	<1.00
Error	60	1917.25	31.95	
Within Subjects				
Tests (T)	1	29.34	29.34	1.25
T X R	3	154.58	51.53	2.19
T X L	2	20.51	10.26	<1.00
T X R X L	6	55.82	9.30	<1.00
Error	60	1410.25	23.50	
Total	143	3781.33		

testing (C_2). All of the difference scores were then coded by adding to each the constant 15. The coded-score statistics appear in some of the tables. None of the F-values is statistically significant. This indicates that the difference scores did not reflect any differential training effects due to levels of rigidity, types of reward, or to any differences in the two tests. The distribution of the coded difference scores for both the Card and Figure Tests are shown in Figure 1.

Analysis of Error Scores

An analysis of variance for the error scores on the Card Test was not calculated for two principal reasons. First, the distributions as seen in Figure 2 are far from being normally distributed, hence would violate the assumption of a normally distributed criterion score. Secondly, by inspection of the curves, it was apparent that there was no significant difference between the curves. This was substantiated statistically by means of the Wilcoxon Matched-Pairs Signed-Ranks Test (Siegal, 1956), and the obtained z-value was 0.790, $p = .215$. Both sets of error scores on the Card Test were considered to be samples from the same population of criterion scores. The implication of this finding is that there was no generalization effect. Training given to a subject on the Figure Test did not improve his second score on the Card Test.

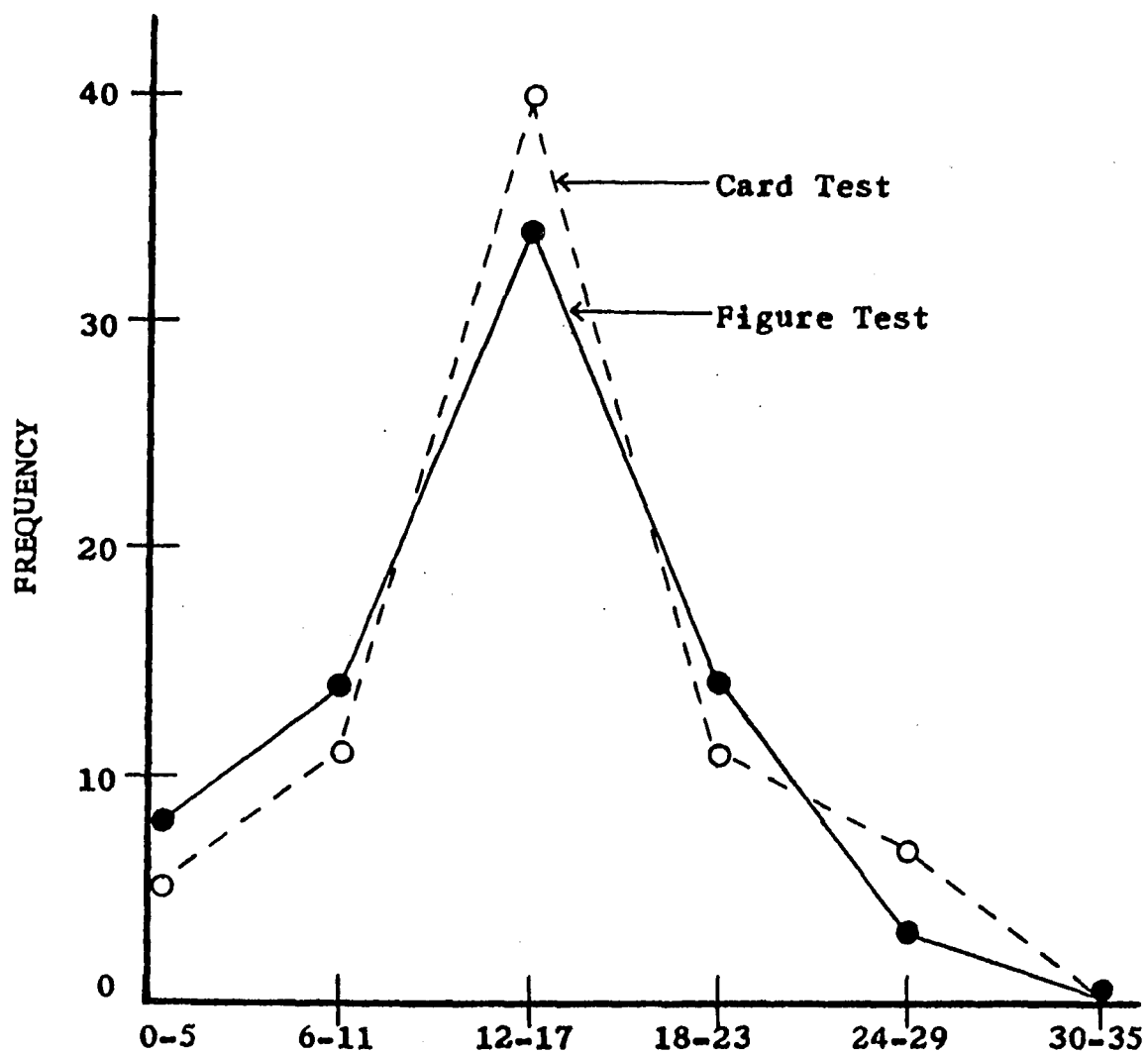


Fig. 1. Distribution of coded difference scores derived from the error scores on the Figure and Card Tests. Difference scores were coded by adding to each the constant 15 ($N=72$).

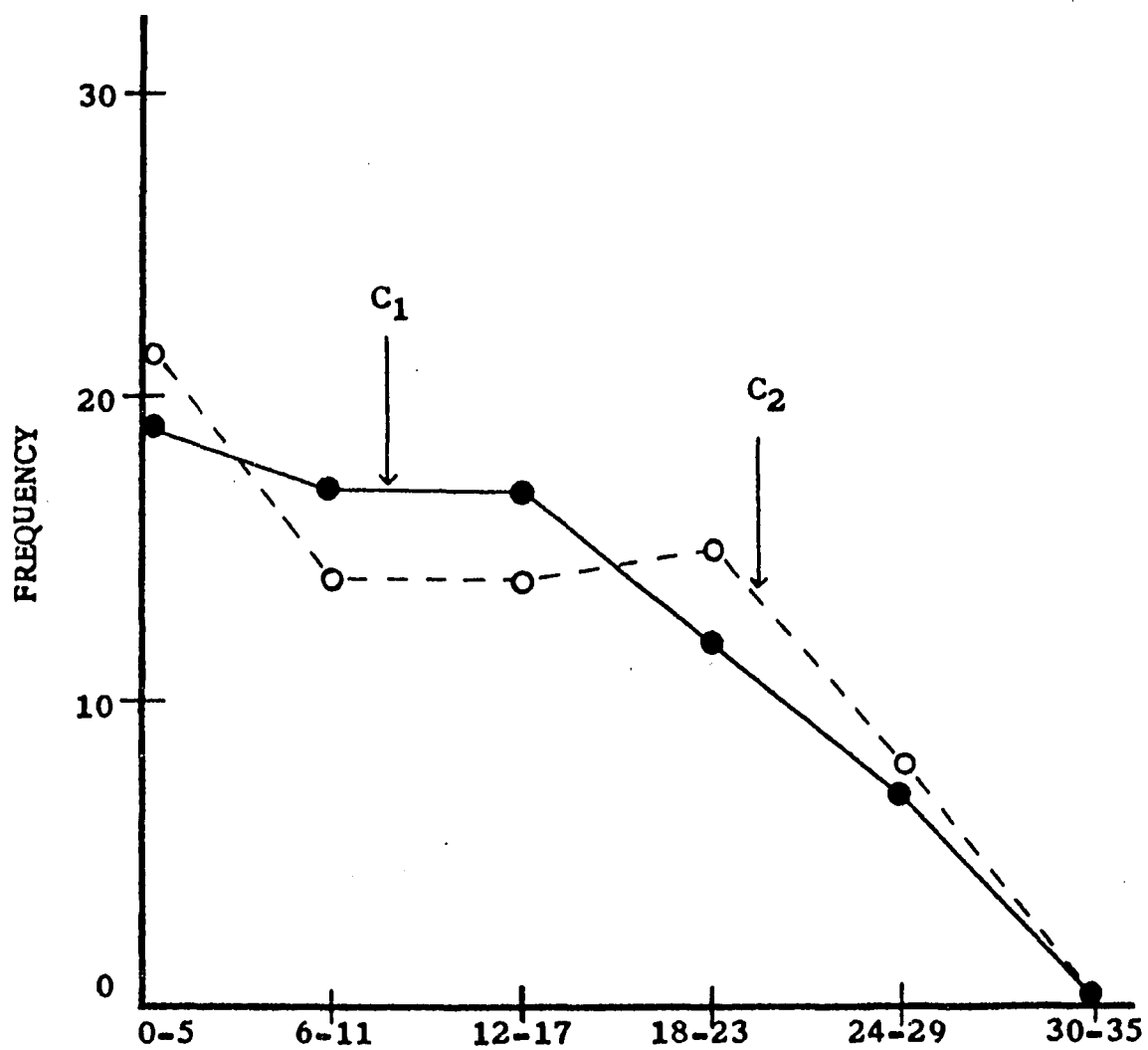


Fig. 2. Distribution of the pretraining error scores (C₁) and training error scores (C₂) on the Card Test¹ (N=72).

Inspection of the distribution of error scores for the Figure Test clearly suggested a difference in the scores obtained before training and those obtained during training. The distributions of these scores appear in Figure 3, and the analysis of variance based on these error scores is summarized in Table 2. In this analysis four variables were included--reward, levels of rigidity, diagnosis, and training. At the 5 per cent level the F-value for training was significant. Two of the F-values were significant at better than the 1 per cent level. These were found for the variable of level of rigidity and with the interaction between diagnosis and reward. The levels of rigidity effect for this analysis was a built-in condition, for the subjects had been assigned to rigidity levels based on their first error scores on the Figure Test (F_1). Neither of the main effects of diagnosis or reward were significant.

The significant training effect means that the first scores on the Figure Test differed significantly from the scores achieved during the rewarded trials in the second testing. Referring again to Figure 3, one observes that the mean of the pretraining scores has shifted to the left with training, i.e., there was a reduction in errors. Therefore, there was an improvement in the performance on this test under the training conditions. At the same time this improvement in scores was not ascribable to any

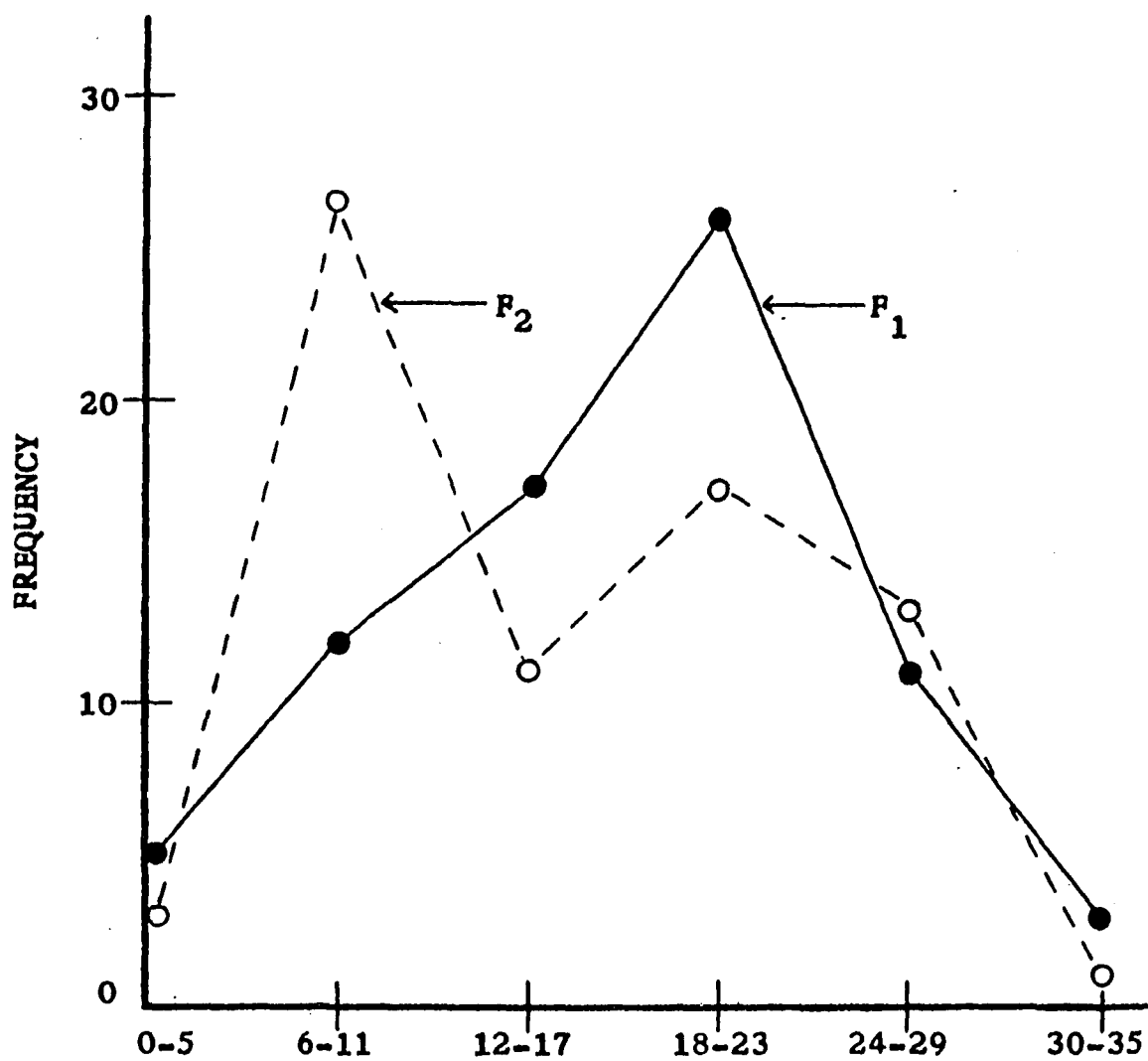


Fig. 3. Distribution of the pretraining error scores (F_1) and the training error scores (F_2) on the Figure Test (N=72).

TABLE 2

Analysis of Variance of Pretraining and Training Scores
on the Figure Test

Source	df	SS	MS	F
Between Subjects				
Rewards (R)	3	25.91	8.64	< 1.00
Levels (L)	2	5154.50	2577.25	118.69**
Diagnosis (D)	1	47.03	47.03	2.17
R X L	6	93.78	15.63	< 1.00
D X R	3	471.61	157.20	7.23**
D X L	2	5.28	2.64	< 1.00
R X L X D	6	-41.46	-6.91	< 1.00
Error	48	1043.29	21.74	
Within Subjects				
Training (T)	1	65.34	65.34	5.32*
T X R	3	23.91	7.97	< 1.00
T X L	2	11.72	5.86	< 1.00
T X D	1	13.73	13.73	1.11
T X R X D	3	19.18	6.39	< 1.00
T X R X L	6	22.78	3.80	< 1.00
T X L X D	2	13.16	6.58	< 1.00
T X R X L X D	6	216.43	36.07	2.93
Error	48	590.25	12.29	
Pooled Error	71	911.16	12.83	
Total	143	7776.44		

*p .05

**p .01

differential effect of the types of reward. Neither the verbal, penny, nor bell rewards were significantly more effective than the control condition of no reward. The F-value for the reward variable is not significant; diagnosis also was not a significant variable in this study.

The significant diagnosis by reward interaction was analyzed further by means of t-tests. The subjects receiving the bell as a reward differed in their scores on the Figure Test. The mean scores and t-values in this reward group are presented in Table 3. By testing the differences between the pretraining and training scores (F_1 and F_2 , respectively), the significance of the interaction was traced to differences in the pretraining scores only (F_1). The psychotics achieved significantly lower pretraining scores than did the CBS subjects. Since only the pretraining scores differed significantly, the diagnosis by reward interaction was simply an artifact of design, i.e., due to the assignment of subjects to the bell reward condition before training was given.

Correlated Variables

Correlation coefficients calculated between the variables of age, diagnosis, vocabulary scores, and test scores are summarized in Table 4. The values between diagnosis and the other variables are point-biserial correlation coefficients. All other coefficients were derived from

TABLE 3

Means and t Values Between Figure Test Scores in the Bell-Rewarded Group for a Given Diagnostic Category (t_F) and Between Diagnostic Categories (t_D)

	$F_1 F_2$	F_1	F_2	t_F
Psychosis	19.83	14.00	12.33	0.87
CBS	13.17	21.44	18.22	1.36
t_D	2.58*	2.09*	1.54	

*p .01

TABLE 4

Correlation Coefficients Among the Variables of Age, Diagnosis, WAIS Vocabulary;
and Pretraining, Training, and Difference Scores on the Figure and Card Tests

	Dx	Age	F ₁	F ₂	C ₁	C ₂	D _F	D _C
Vocabulary	.09	-.05	-.45**	-.48**	-.32**	-.41**	-.08	-.18
Age	.14		.24*	.28**	.24*	.20*	.12	-.02
F ₁				.77**	.61**	.63**	-.25*	.10
F ₂					.61**	.68**	.41**	.16
C ₁						.80**	.09	-.20*
C ₂							.15	.41**
D _F	.11							.11
D _C	.10							

*p .05

**p .01

Pearson product-moment correlations. Several of these values are significant at less than the 1 per cent level. Vocabulary scores are negatively correlated with the pre-training and training scores of both the Figure and Card Tests. The negative correlation here means that the higher vocabulary scores were associated with better performance on the Figure and Card Tests, i.e., with lower error scores. Age is positively correlated with the training score of the Figure Test (F_2) at the 1 per cent level of confidence and with the pretraining scores of both tests (F_1 , C_1) and the training score of the Card Test (C_2) at the 5 per cent level. These significant correlation coefficients imply that with increasing age the subjects made more errors on both tests, particularly in the training phase of the Figure Test. This finding tends to support the belief mentioned in the Introduction that rigidity does increase with increasing age. The inverse relationship between the I.Q. and rigidity measure suggests further that these three variables interact. With increasing age a person may become more rigid with a consequent reduction in intellectual efficiency.

Nine other significant correlations are found among the Figure and Card Test scores. Only one of these relationships is of particular interest in this study, namely, the one between the pretraining scores of both the Figure and Card Tests (F_1 , C_1). There is a positive

relationship between these scores, and it indicates the degree of similarity between the two tests. Approximately 37 per cent of the variance in each test is common to both. No relationships were found between diagnosis and the variables of age, vocabulary, or difference scores. Age and vocabulary scores also were not significantly correlated with the difference scores.

Additional Analyses

Means and standard deviations were calculated for the variables of test scores, age, and vocabulary. The distributions of the latter two measures were broken down further into diagnostic categories. Table 5 summarizes these descriptive statistics. It is interesting to note that the two diagnostic groups were fairly well matched with respect to age and I.Q.

A definite experimenter effect was found as shown by the t values in Table 6. The pretraining and training scores on both the Figure and Card Tests differed significantly across experimenters (E_1 and E_2).

TABLE 5

Means and Standard Deviations for the Figure and Card
Test Scores, and Age and WAIS Vocabulary Measures
Distributed in Diagnostic Categories

		Mean	S.D.
Age (years)	Psychosis	69.2	3.54
	CBS	70.2	3.72
	Combined	69.6	3.64
Vocabulary	Psychosis	30.8	22.51
	CBS	27.3	18.68
	Combined	29.2	19.21
Figure Test	F ₁	16.9	7.08
	F ₂	15.5	7.52
Card Test	C ₁	12.1	8.00
	C ₂	11.6	8.63
Diff. Scores	D _F	13.7	4.87
	D _C	14.5	5.23

TABLE 6

Means and t Values Calculated for the Figure Test
Scores Obtained Under Each Experimenter

	E ₁	E ₂	t
F ₁	14.54	19.74	3.35*
F ₂	12.78	18.83	3.36*
C ₁	9.49	14.77	2.98*
C ₂	7.92	15.80	4.35*

*p .01

DISCUSSION AND CONCLUSIONS

Training Effect

The most pressing and unanswered question to be considered from the results is that of what influenced the improvement in the subjects' Figure Test error scores. From the statistical data it is obvious that the effect was not due to the types of rewards used in this study. The verbal, penny, and bell groups showed improvement in error scores, but so did the controls who received no known rewards. All four groups did equally well on second testing. What, then, might be the rewarding conditions which contributed to the improved performance even for the control group?

The one set of variables that probably contributed most to the training effect are those derived from the social setting in which the experimental variables were introduced. The subjects might well have been motivated to perform simply by the presence of an interested experimenter. Being singled out and taken into another area of the building on at least two separate occasions might have contributed to the improved performance. Other similar conditions could be hypothesized to account for the test performance. Staff members on the geriatric unit housing

some of the subjects in this study have observed and commented upon the positive responsivity of the patients to warm social contact. All but the most withdrawn of these patients would react positively to some extent to continual, patient, and friendly interest in their well-being. These observations led to the institution of an intensive and successful remotivation program on this geriatric unit.

If the motivational variables just mentioned did lead to improved performance on the Figure Test, then one could expect to see a similar influence carried over to the Card Test. Such was not the case. One possible explanation is that there might be a considerable difference between the two tests with respect to their interest value. The Figure Test perhaps was more challenging or novel than the Card Test. Nonetheless, the influence of the motivational and test variables, though unanswerable by the data in the present study, are germane for further research.

In considering other possible variables to account for the change in performance, one immediately could suspect a practice effect. Such a possibility, however, does not seem feasible. Practice would also have improved the scores on the correlated Card Test, which was not entirely the case. Though there was a slight overall improvement in the Card Test scores (see Table 5), it was not as great as that occurring with the Figure Test scores. Granted some practice effect may have influenced both test performances,

certainly it was not sufficient enough in magnitude to account for the greater improvement on the Figure Test.

Rewards

A possible explanation for the absence of a differential reward effect may lie in the nature of the Figure Test itself. Scores on this test may not be amenable to improvement through conditioning. However, referring again to the study by Grant and Berg (1948), it should be noted that the test they used, the Wisconsin Card Sorting Test, is reasonably similar to the Figure Test of the present study. Though the method of presentation of the stimulus material differs, the nature of the material and the principle of matching the concepts to obtain correct responses are similar. Through the application of verbal reinforcements, Grant and Berg were able to improve their subjects' performance on the experimental task with as few as 10 rewarded trials. Therefore, attributing the lack of a differential reward effect to the nature of the test itself is not an entirely feasible explanation. Assuming a reasonable similarity between the Wisconsin Card Sorting Test and Figure Test, it is unlikely that intrinsic task features prevented a differential reward effect.

An inadequate number of rewarded trials on the Figure Test is one other possible reason for no specific reward effect. Out of the 36 training trials, each of the three

concepts (size, shape, and color) were rewarded no more than nine times and less than that for most subjects. The maximum number of possible reinforced shifts in concept was 36, and this, too, was rarely achieved by any of the subjects. It is possible that with only this many reinforcements, a particular reward's effect was not yet in evidence over and above the positive effect of any of the other variables mentioned. This question could be answered easily by increasing the number of reinforcing trials. However, a clinical observation should be cited here in defense of the limited number of reinforced trials utilized in this study. It was this experimenter's impression that 36 trials very nearly reached the limit of many subjects' patience and interest. One way around this situation might be to reduce the number of concepts to two, e.g., color and shape, and then increase the number of trials. The task would probably be a little easier and less taxing for the subjects.

Generalization

The failure to achieve a generalization of training effect on the Card Test might be accounted for by the same explanations presented in the case of differential reward effect. Nonetheless, the lack of a generalization effect has an interesting and practical implication when coupled with the overall positive training effect. This combination of results suggests that any training procedures

conducted with geriatric-psychiatric subjects can be expected to be successful but rather situation-bound. For example, if these subjects were to be trained on some practical behavior patterns (eating habits or personal hygiene), there might not be much transfer or generalization of this training to other related behavior patterns or settings.

Diagnosis

Diagnosis proved not to be a relevant variable in the present study. In other words those subjects diagnosed chronic brain syndromes (CBS) performed as well as the psychotic group. At first this appears to violate the theoretical expectations derived from the Goldstein position discussed earlier. On the experimental task CBS cases should do worse than other subjects because of the increased rigidity associated with brain damage. Again, this was not true in this study. A look at Table 7 may provide an explanation for these results. In this table appears the distribution of subjects according to the two gross diagnostic categories CBS and psychosis, and the various subcategories within each of these. First to be noted is the large overlap in the two basic categories. At least 61 per cent of the cases with CBS carry a concomitant diagnosis of psychosis. With such a large overlap there is little wonder that a differential effect did not appear. Considering,

TABLE 7

The Frequencies and Percentage of Subjects Distributed
in the Various Diagnostic Categories

	f	%	% of total Ss
CBS associated with:			
Cerebral Arteriosclerosis (CAS)	6	18	8
CAS and Psychosis	12	35	17
Syphilis	4	12	6
Syphilis and Psychosis	5	14	7
Psychosis	4	12	6
Other Conditions	3	9	4
Total	34	100	48
Psychoses:			
Schiz. React., Paranoid	8	21	11
Hebephrenic	16	42	22
Undifferentiated	6	16	8
Manic Depressive	3	8	4
Others	5	13	7
Total	38	100	52

too, the incidence of brain deterioration with age alone, it is possible that many of the psychotics suffered from the effects of cerebral arteriosclerosis without being diagnosed as such. This would be quite likely for those patients who had been hospitalized a number of years and for whom re-evaluation of an old diagnosis was not undertaken. Other explanations for the non-significance of the diagnosis variable could be sought in the controversies over the reliability of diagnostic categories or in the difficulty of differential diagnosis of psychotic versus organic features in test data. Discussion of these latter explanatory areas is beyond the scope of this study.

Levels of Rigidity

The stability of the levels effect under the training conditions has already been mentioned; however, there are some further implications to this result. Most subjects assigned to a given level remained within this level after training. Table 8 shows the means and standard deviations for the pretraining and training scores of the Figure Test at each level of rigidity. Despite the stability of the levels, the overall positive training effect was present even with the most rigid of subjects. This result, then, supports the hypothesis that rigid behavior, at least as measured in the present study, is modifiable and is done so in the direction of greater flexibility. The results

TABLE 8

Means and Standard Deviations of Figure Test Scores
for the Three Levels of Rigidity

		Mean	S.D.
L_1	F_1	9.08	3.33
	F_2	8.54	2.45
L_2	F_1	17.79	2.27
	F_2	16.08	6.67
L_3	F_1	24.33	3.59
	F_2	22.54	4.94

suggest further that rigidity is not necessarily an insurmountable deterrent to the training or conditioning of geriatric-psychiatric patients in rehabilitative programs.

Experimenter Differences

The most feasible explanation for the significant difference between experimenters would be to point out possible differences in the personalities and experience of the individuals. However, one other variable has confounded those just mentioned. To expedite the data collection, Experimenter 2 drew 30 subjects from the geriatric unit and four from another ward. Experimenter 1 drew 38 subjects from wards not on the geriatric unit. A general practice in this hospital was to transfer to the geriatric unit those patients who required closer supervision and more nursing care. Therefore, among the 72 subjects in the study there were samples from at least two slightly different populations of patients. Experimenter 2 was probably sampling a more impaired population on the geriatric unit (see Table 4). The experimenter difference, then, probably reflects both the latter condition and the personal difference between testers.

Concept Formation Tests

The Figure and Card Tests devised for the present study proved to be suitable in several respects. They were simple to administer and score, required a minimal, non-verbal

response (pointing to one figure) to indicate an answer, and, as mentioned earlier, were not overly taxing on the subjects. No subjects were lost because they could not comprehend the nature of the task. On the negative side, one concept on each test was obviously more difficult than the other two. The size concept on the Figure Test was quite difficult for most subjects; the color concept was most difficult on the Card Test. This feature probably reduced the training effect by being difficult to comprehend in the number of trials allowed. It would be better to have concepts more equal in difficulty, particularly since the emphasis in this study was upon the shifts among concepts, not upon the learning of the concepts, per se. If ceiling is needed for the tests, the overall difficulty level could be increased. Reviewing Figure 2, it is obvious that the Card Test did not have sufficient ceiling which, in turn, probably reduced the possibility of a generalization effect.

Geriatric Subjects

Some comments need be made about the behavior of the geriatric-psychiatric subjects utilized in the study. Cooperativeness was the most difficult feature of this group to deal with. At least half of the subjects showed some oppositional tendencies during the testing sessions. They seemed reluctant to engage in any kind of intellectual

exercise either out of lethargy, indifference, or fear of failure. In some cases this oppositional trend increased when the subjects were recalled for the second and third test sessions. These subjects required patient urging and supportive comments initially, but once started, they were able to complete the tests unsupported. The possibility of losing oppositional subjects after the first test session was ever present; however, no more than five such subjects actually dropped out before completing the final test session. Interest in the tests ran from paranoid suspiciousness to an interest in theoretical implications. Interest and cooperativeness were not obviously related to performance on the tests. One subject who was quite talkative and interested in the tasks did rather poorly on them. Another subject who said very little and seemed impatient to get the whole business over with did quite well on the tests. All in all, the geriatric-psychiatric subjects were difficult and unpredictable to work with. This is probably one reason why so little research has been attempted with this group to date.

Design Improvements

Several improvements in the experimental design other than those already suggested will now be presented. The first to be considered is the measure of rigidity. The use of error scores as this measure is believed by the writer

to reflect sources of variance other than rigidity alone, e.g., the inability of a subject to understand a concept, particularly those mentioned above, or sheer guessing by the subjects. Some measure of perseverative responses would probably be a more suitable indication of rigidity than the error score alone. Perseverative responses were used as measures of rigidity in several of the studies previously cited in the Introductory section.

Another design improvement would be to counterbalance both the administration and training for both tests, i.e., give half the subjects the Figure Test first followed by the Card Test, and vice versa for the remaining subjects. Also, train half of the subjects on the Figure Test and the other half on the Card Test. This procedure should reduce the influence of task differences on any reward or generalization effect.

The seven-day period between the first and second test session seemed unnecessarily long even though it was planned to insure against a practice effect for the second testing session. A three-day delay between sessions one and two would probably be ample in this respect, and it would expedite the data collection timewise. Also, the reduced total testing time for a single subject would help avoid a loss of subjects because of medical appointments or leave of absences, and could help sustain a subject's interest over

time.

Another suggested design improvement relates to differences in test performance as a function of age. A group of younger adult subjects could be included and matched with the aged subjects on such variables as IQ and diagnosis. This comparison would help clarify the effects of aging, per se, on trainability. Unfortunately, the two tests devised for the present study were so simple that the performance of younger subjects would have been severely affected by the low ceilings. Four members of the nursing staff were administered the tests, and all of these people made no more than three errors on either test. What would be needed is a test that contains several groups of concepts differing in level of difficulty but which contains two or more concepts of equal difficulty within any one level. Such a test would provide an adequate ceiling for subjects in a broader age group and would allow more accurate comparisons across groups.

Conclusions

From the overall results of this study some general conclusions can be summarized. The first and most promising impression is that rigidity in behavior is not an irreversible phenomenon. Second, it is susceptible to modification through training, specifically by operant conditioning. And third, these results lend supportive evidence to

encourage the continuation and expansion of the rehabilitative efforts being utilized with aged individuals. Though these generalizations may seem rather grandiose, they are offered only as cautious extrapolations from the data and must be evaluated with the weaknesses of the present experimental procedures in mind.

SUMMARY

The purpose of this study was to discover if rigidity in aged subjects could be modified (reduced) through training by operant conditioning. The measure of rigidity was defined as the error scores achieved on a simple concept formation test devised by the writer. The scores reflected the ability of the subjects to shift their attention among randomly presented concepts--color, size, or shape. Three types of rewards were used during training--a positive verbal statement, a penny, and the sound of a tap bell. A control group received no reward. The subject sample consisted of 72 geriatric-psychiatric patients 65 years of age and older and carried diagnoses of either chronic brain syndrome or psychosis. The subjects were assigned to one of three levels of rigidity according to their error scores on the pretraining administration of the first concept formation test. Generalization of training was also investigated by the use of a second and similar concept formation test.

Three specific hypotheses were tested:

1. Rigidity can be modified through training by the application of positive reinforcements.
2. Verbal and non-verbal reinforcers will differ in their efficiency in modifying rigidity.

3. The modification of rigidity in one behavioral area will generalize to modify rigidity in a related behavioral area.

Analyses of variance based on error scores of the two concept formation tests produced the following results:

1. A significant training effect ($p < .05$) was demonstrated between the pretraining and training scores of the Figure Test. These data supports the first hypothesis.
2. No significant differential reward effect occurred, negating the second hypothesis. This indicates that the training effect was influenced by some other variable, probably social facilitation.
3. No generalization effect was elicited on the Card Test, negating the third hypothesis. This finding indicates how situation-bound this training might be.
4. Diagnosis was not a significant variable.
5. There were significant differences among the levels of rigidity ($p < .01$). The lack of significant interactions of this variable with the other measures suggested that the subjects showed a training effect despite the degree of rigidity they displayed.

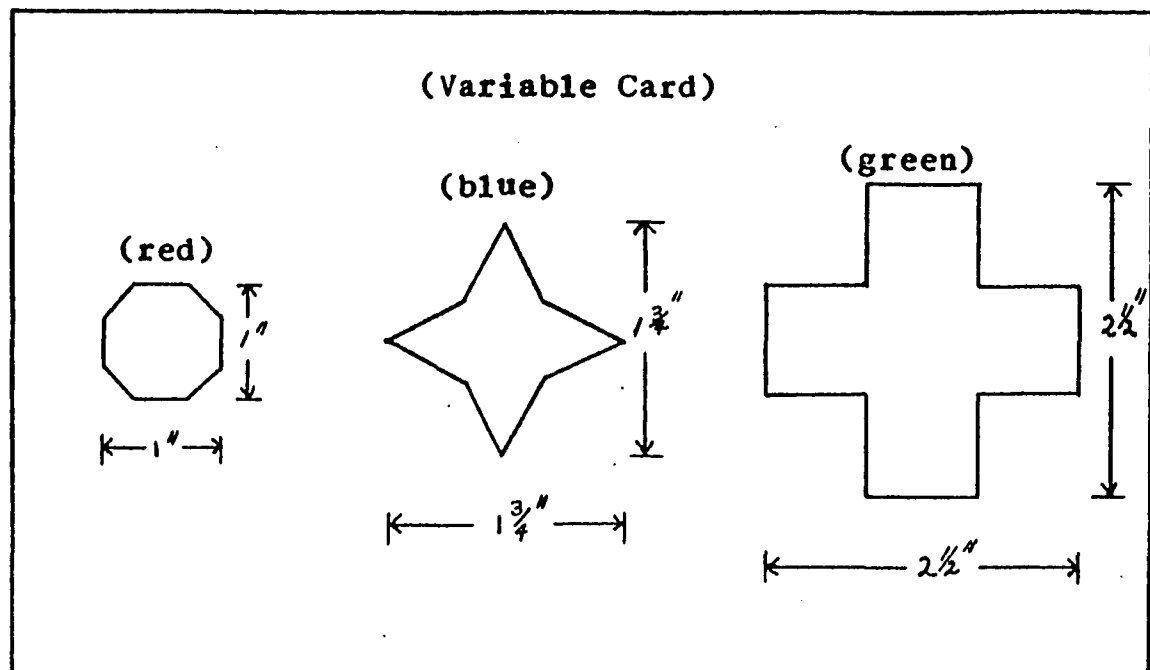
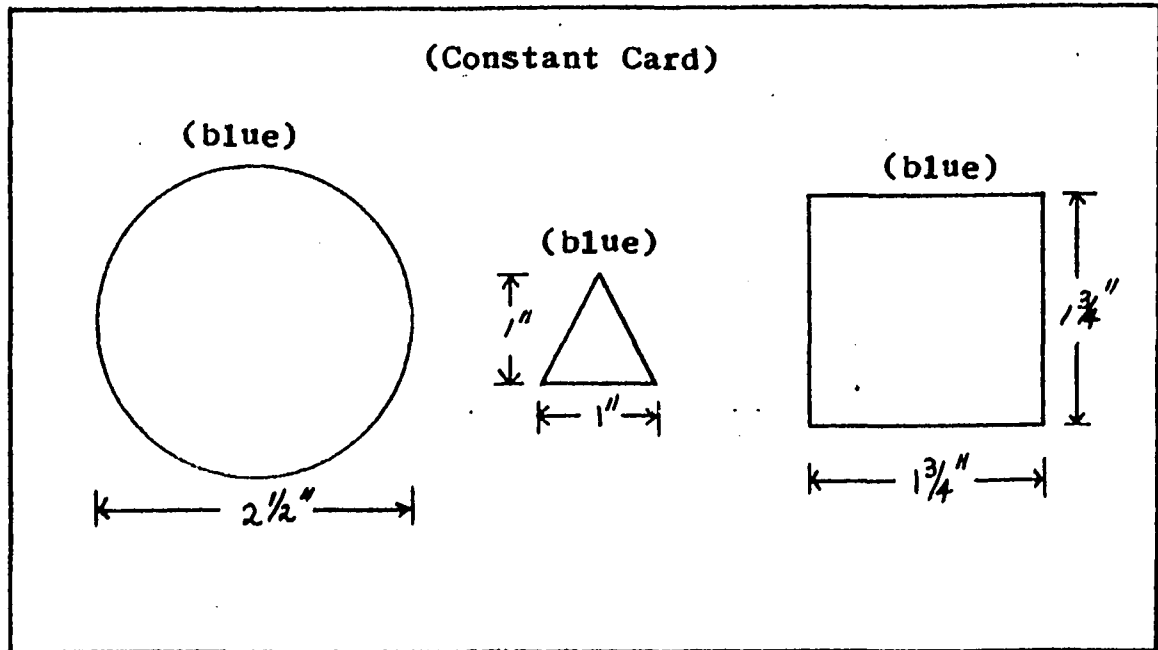
The variables of age and I.Q. (WAIS vocabulary subtest) were correlated with the test scores. Age was found to be

inversely related to the error scores of both tests, indicating that rigidity does increase with age. I.Q. was directly related to the error scores, indicating that with increased rigidity intellectual efficiency decreases.

The overall conclusions from the data were that rigidity is not an irreversible phenomenon, that it can be modified through conditioning. Rigidity, then, is not an insurmountable obstacle to rehabilitative programs applied to aged individuals.

APPENDICES

The Placement and Dimensions of the Figures on Pair I
of the Figure Test



APPENDIX B

The Sizes, Colors, and Shapes of the Figures
Distributed on the Constant Cards (C) and
Variable Cards (V) of Figure Test

Pair I (left to right)

C: large blue circle, small blue triangle, medium blue
square

V: small red octagon, medium blue star, large green
cross

Pair II

C: large red circle, large blue triangle, large green
square

V: small green star, large red octagon, medium blue
cross

Pair III

C: medium green circle, small green square, large
green triangle

V: medium red star, large green cross, small blue
octagon

Pair IV

C: medium red circle, large green circle, small blue
circle

V: small black star, large black octagon, medium black
circle

Pair V

C: medium red circle, large red triangle, small red
square

V: large blue star, small red cross, medium green
octagon

Pair VI

C: medium blue square, large green square, small red
square

V: large black star, medium black octagon, small black
square

Pair VII

C: medium green circle, medium blue triangle, medium
red square

V: medium black cross, small red star, large green
octagon

Pair VIII

C: small green triangle, small red circle, small blue
square

V: small red cross, large green octagon, medium blue
star

Pair IX

C: medium blue triangle, small green triangle, large
red triangle

V: medium black star, large black cross, small black
triangle

APPENDIX C

The Numbers, Suits, and Colors, of the Playing
Cards Distributed on the Constant Cards (C)
and Variable Cards (V) of the Card Test

Pair I (right to left)

C: three of diamonds, three of hearts, three of spades

V: five of spades, seven of hearts, three of clubs

Pair II

C: seven of clubs, three of clubs, five of clubs

V: two of clubs, six of hearts, four of spades

Pair III

C: seven of clubs, seven of hearts, seven of spades

V: seven of diamonds, three of hearts, five of spades

Pair IV

C: seven of spades, five of spades, three of spades

V: two of hearts, six of clubs, eight of spades

Pair V

C: five of clubs, five of hearts, five of spades

V: seven of spades, five of diamonds, three of clubs

Pair VI

C: five of hearts, seven diamonds, three of hearts

(all red)

V: six of clubs, four of spades, six of diamonds

Pair VII

C: five of diamonds, seven of diamonds, three of diamonds

V: four of clubs, two of diamonds, eight of hearts

Pair VIII

C: three clubs, five of clubs, seven of spades (all black)

V: six of hearts, eight of diamonds, two of spades

Pair IX

C: seven of hearts, three of hearts, five of hearts

V: eight of hearts, four of clubs, two of diamonds

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VITA

Kyle K. Coleman was born in Williams, California, on May 21, 1929, and graduated from the Williams Union High School in 1947. He then enrolled at Yuba College, Marysville, California, to pursue a premedical curriculum. An Associate of Arts degree was received in 1949. Following enrollment at the University of California, Berkeley, California, he received the Bachelor of Arts degree in Physiology in January, 1952. Mr. Coleman enlisted in the U.S. Air Force in September, 1952, and served four years as a psychiatric technician in the medical corps.

In 1956, Mr. Coleman returned to the University of California to obtain a second Bachelor of Arts degree with a major in Psychology. This degree was conferred in January, 1957. Graduate study for a Master of Arts degree in Psychology was nearly completed in 1959 at Fresno State College, Fresno, California. Mr. Coleman then enrolled at the Louisiana State University, Baton Rouge, Louisiana, for graduate study leading to the Doctor of Philosophy degree in Clinical Psychology. The Master of Arts degree was conferred in June, 1962. His clinical experience includes three months of practicum training at Kingsview Hospital, Reedley, California; nine months of part-time employment as

a psychologist at the East Louisiana State Hospital; 18 months full time internship at the V.A. Hospital in Gulfport, Mississippi; and, to date, five months full time internship at the Mental Hygiene Clinic, V.A. Regional Office, New Orleans, Louisiana.

EXAMINATION AND THESIS REPORT

Candidate: Kyle K. Coleman

Major Field: Clinical Psychology

Title of Thesis: THE MODIFICATION OF RIGIDITY IN GERIATRIC PATIENTS THROUGH
OPERANT CONDITIONING

Approved:

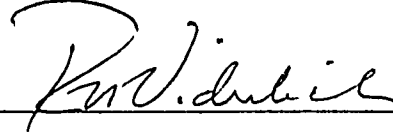


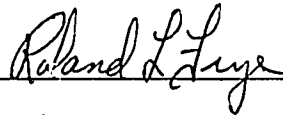
Major Professor and Chairman

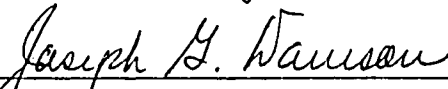


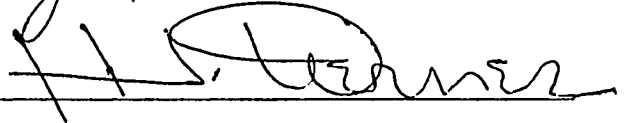
Dean of the Graduate School

EXAMINING COMMITTEE:









Date of Examination:

5 March 1963